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New energy levels in the spectrum of neodymium—Nd I

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New neodymium lines (14284) in the spectral region 9080Å – 2100Å are observed during our recent measurements of the spectra By means of our new list of wave numbers, we discovered 45 levels, 16 low even and 29 odd ones From the Zeeman effect splittings we determined the g-factors of 38 levels only and checked their j-values

1. Introduction

The aim of this work is to establish a complete accurate wavelength list for the extension of the analysis of Nd-Spectra

It was found that all the trials previously made by different investigators (Hassan 1963, Hassan & Klinkenberg 1963, Klinkenberg 1946) are far from being complete and the accuracy of their data could be improved

2. Experimental

Klinkenberg of the Zeeman Laboratory, Holland, took part in these investigations by providing us with a new set of Nd-Spectrograms Due to some difficulties the major part of the measurements were done at the physics department of Al-Azhar University, Cairo, and then the rest was done in the Physics Department of the Assiut University (Turki 1974). This did not affect in any way the accuracy of our work The lines were measured in different orders and the method of linear interpolation was applied and calculations of wavelengths were done to eight figures The standard lines were argon, neon and iron. Their wavelengths were obtained from the wavelength tables of Lofthus (1956) To examine the degree of our accuracy we checked the values of some extra standard lines

As a result of the measurements were recorded 14824 Nd-lines covering the wavelength region between 9080Å and 2100Å. It is worth mentioning that there appeared in our wavelength list all King's furnace lines (King 1933) and also the lines with comparable intensity in the list published earlier by one of the authors

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(Hassan 1963) The inaccuracy of our wavenumbers lies within ± 0.10K for sharp lines and this is better than all previous work

3 Analysis

Searching for energy levels in such a complex spectra we started with the known levels, accordingly differences between already known odd levels served as a starting point The physical existence of the level was ascertained by its number of combinations It was decided to ignore levels having less than 90% of its theoretical combinations existing in our wavelength list and in the meantime we allowed for a tolerance of ± 0.10K in the combination We decided to do that due to the weak lines which we took into consideration from the beginning and to prevent the chance of accidental equal differences. This severe criteria allowed us to accept the levels as candidates

Our next step was to check the physical reality of these levels This was done by Zeeman effect measurements which is indeed a powerful check and gives additional information pertaining to the levels i e the g-and the p-values which are very helpful for determining the origin of the levels As a further step and to reassure the reality of the level we took into consideration the isotope shift for a number of the combinations As a result, 16 levels in the low even group and 29 odd level have been discovered and are added to the existing Nd-I scheme Summing up we can say that the classified lines are now 1096 instead of 555 The new discovered levels are tabulated in tables 1 and 2

Table 1 Low even levels of Nd I

Code No	Relative term value	J	g(exp)
137	1377.24	3	0 53
509	3091 16	6	0 965
510	5101.21	8	1.167
511	5112 13	9	
563	5635 78	7	
685	6854.88	9	
686	6856 33	7	1 32
789	7897.52	9	1 17
850	8509 20	5	0 85
869	8692 25	(3 4)	
872	8721 01	7	
932	9324 74	7	1 42
961	9613 44	11	1 45
997	9978.50	9	
1013	10133 38	9	1 197
1085	10850 11	9	1 126

Table 2 Odd levels of NdI

Code No	Relative term value	J	g(exp)
1650	16505 77	5	0 83
1677	16671 84	6	0.97
1668	16676 05	6	1 01
1710	17104 98	6	1 01
1720	17209 05	5	0 72
1738	17387 39	5	0 70
1805	18054.15	7	1.085
1922	19226 38	4	0 93
1970	19700 90	5	0.58
2037	20370 01	5	0 76
2039	20395 95	5	0 79
2046	20464 92	7	1 045
2068	20682 84	5	1 11
2152	21522.89	4	0.942
2237	22376 38	(5, 6)	
2389	23899 13	6	1 17
2445	24454 12	8	1.05
2448	24480 45	8	1 11
2451	24513 64	5	0.59
2492	24921 04	8	1 11
2499	24992 38	5	0 44
2502	25023 11	7	0 99
2525	25254.40	8	1 07
2562	25622 59	8	1 12
2591	25910 21	8	1 23
2696	26963 13	8	1 07
3024	30240 10	8	1 17
3043	30432.95	9	1.118

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